Hierarchically mesoporous carbon nanopetal based electrodes for flexible supercapacitors with super-long cyclic stability

Jayesh Cherusseri[a] and Kamal K. Kar[a,b*]

[a]Advanced Nanoengineering Materials Laboratory, Materials Science Programme, Indian Institute of Technology, Kanpur, Uttar Pradesh-208016, India.

[b]Advanced Nanoengineering Materials Laboratory Department of Mechanical Engineering, Indian Institute of Technology, Kanpur, Uttar Pradesh-208016, India.

*Corresponding Author. Tel: +91-512-2597687, E-mail: kamalkk@iitk.ac.in (Kamal K. Kar)

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Table S1. Comparison of gravimetric capacitances achieved by the various carbon nanomaterials based supercapacitors.

Ref.	Electrode Material/s	Electrolyte	$C_{sc,sp,m}$ (F/g)
[S2]	SWNTs	1 M NaCl (aqueous)	25-30
	MWNTs	1 M NaCl (aqueous)	6-10
[S3]	MWNTs	1 M $LiPF_6$ (EC-DEC)	35
[S4]	Normal CNTs	1 M $LiClO_4$ (EC-DEC)	25
	Activated CNTs	1 M $LiClO_4$ (EC-DEC)	50
[S5]	CO_2-oxidized CNTs	--	47
[S6]	MWNTs	6 N KOH	21
[S7]	MWNTs	1 M H_2SO_4	25.4
[S8]	SWNTs	6 M KOH	40
[S9]	Pristine CNTs	Aprotic electrolyte	12.9
	Pristine CNTs	Protic electrolyte	10.9
	Cup-stacked CNTs	Aprotic electrolyte	55.7
	Cup-stacked CNTs	Protic electrolyte	28.4
[S10]	Pristine DWNTs	0.5 M H_2SO_4	22
	Pristine DWNTs	1 M Et_4NBF_4/PC	34
	DWNT-HNO_3	0.5 M H_2SO_4	54
	DWNT-HNO_3	1 M Et_4NBF_4/PC	38
[S11]	MWNTs grown on metals	6 M KOH	10.75-21.57
[S12]	CNTs grown on Ni-foam	6 M KOH	25
[S13]	SWNT film	1 M $LiClO_4$ (EC-DEC-DMC)	35
[S14]	MWNTs	38 wt% H_2SO_4	113
[S15]	SWNTs	7.5 N KOH	180

Present Work	**CNPs synthesized on UCF**	**5 M KOH**	**220 (at 2.77mA/cm^2)** **154 (at 16.66mA/cm^2)**

Method S1. Calculation of ionic conductivity of CNPs/UCF electrodes.

The ionic conductivity of the supercapacitor electrodes is calculated by using the equation

$$\sigma = \frac{T}{R_b \ X \ A}$$

Where σ is the ionic conductivity in S/cm, T is the total thickness of the supercapacitor cell (in cm), R_b is the bulk electrolyte resistance (in Ω), and A is the geometrical area of electrodes (in cm^2).

Method S2: Calculation of discharge capacitance of CNPs/UCF supercapacitor.

The discharge capacitance of the supercapacitor is calculated by using equation

$$C_{sc} = \frac{It_{dis}}{\Delta E}$$

Where, C_{sc} is the discharge capacitance of the supercapacitor, I is the charging current, t_{dis} is the discharging time, and ΔE is the operating potential window.

Method S3: Calculation of areal capacitance of CNPs/UCF supercapacitor.

The areal capacitance of the supercapacitor is calculated by using the equation

$$C_{sc,\,A} = \frac{C_{sc}}{A_{sc}}$$

Where, $C_{sc,\,A}$ is the areal capacitance of the supercapacitor and A_{sc} is the total geometric area of two supercapacitor electrodes (i.e., two times the area of single electrode).

Method S4: Calculation of volumetric capacitance of CNPs/UCF supercapacitor.

The volumetric capacitance of the supercapacitor is calculated by using the equation

$$C_{sc,\,V} = \frac{C_{sc}}{V_{sc}}$$

Where, $C_{sc,\,V}$ is the volumetric capacitance of the supercapacitor and V_{sc} is the total volume of the supercapacitor (total volume of two supercapacitor electrodes + volume of the separator with electrolyte).

Method S5: Calculation of volume specific capacitance of CNPs/UCF supercapacitor.

The volume specific capacitance of the supercapacitor is calculated [S1] by using the equation

$$C_{sc,\,sp,\,V} = 4\ X\ \frac{C_{sc}}{V_{el}}$$

Where, $C_{sc,sp,V}$ is the volume specific capacitance of the supercapacitor, C_{sc} is the discharge capacitance of the supercapacitor, V_{el} is the total volume of two supercapacitor electrodes (the volumes of separator with electrolyte is not considered).

Method S6: Calculation of volume specific energy density of CNPs/UCF supercapacitor.

The volume specific energy density of the supercapacitor is calculated by using the equation

$$E_{sc,\,sp,\,V} = \frac{C_{sc,\,sp,\,V}\ X\ (\Delta E)^2}{2\ X\ 3600}$$

Where $E_{sc,sp,V}$ is the volume specific energy density and all other variables as defined above.

Method S7: Calculation of volume specific power density of CNPs/UCF supercapacitor.

The volume specific power density of the supercapacitor is calculated by using the equation

$$P_{sc,\,sp,\,V} = \frac{E_{sc,\,sp,\,V}\ X\ 3600}{t_{dis}}$$

Where $P_{sc,sp,V}$ is the volume specific power density and all other variables are defined above.

Method S8: Calculation of gravimetric capacitance of CNPs/UCF supercapacitor.

The gravimetric capacitance of the supercapacitor is calculated by using the equation

$$C_{sc,sp,m} = \frac{I\ X\ t_{dis}}{M\ X\ (\Delta E)} = \frac{C_{sc}}{M}$$

Where, 'M' is the total mass of CNPs in the two electrodes of the supercapacitor (excluding the mass of UCFs, separator, and electrolyte), and other variables are discussed above.

Method S9: Calculation of gravimetric energy density of CNPs/UCF supercapacitor.

The gravimetric energy density of the supercapacitor is calculated by using the equation

$$E_{sc,\,sp,\,m} = \frac{C_{sc,\,sp,\,m}\ X\ (\Delta E)^2}{2\ X\ 3600}$$

Where $E_{sc,sp,m}$ is the gravimetric energy density and all other variables are defined above.

Supplementary Figures:

Fig. S1. Assembly of CNPs/UCF supercapacitor cell by using CNPs/UCF electrode-cum-current collectors.

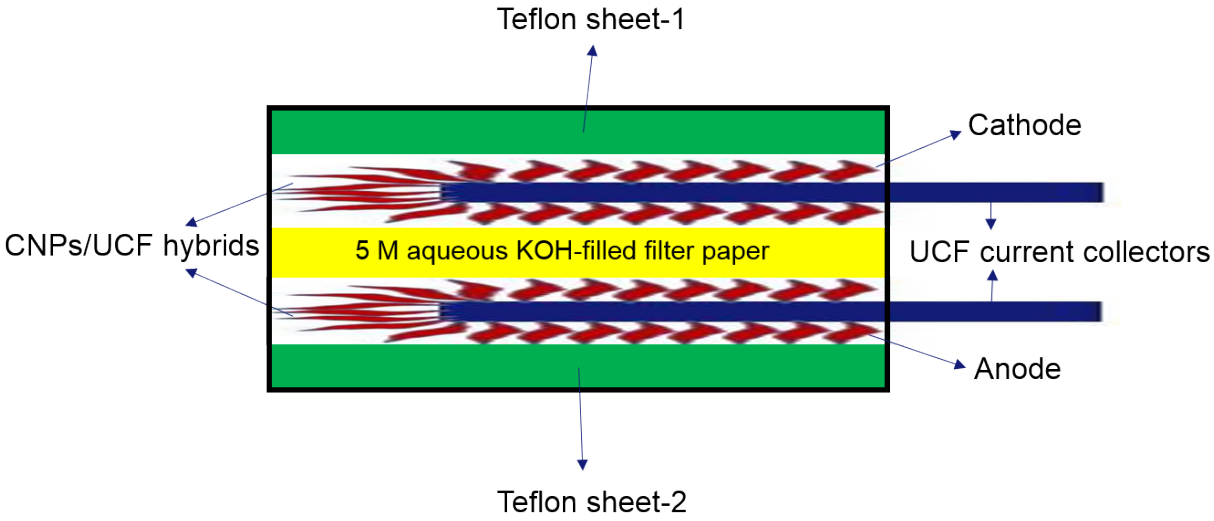


Fig. S2. SEM image of nickel-coated UCFs.

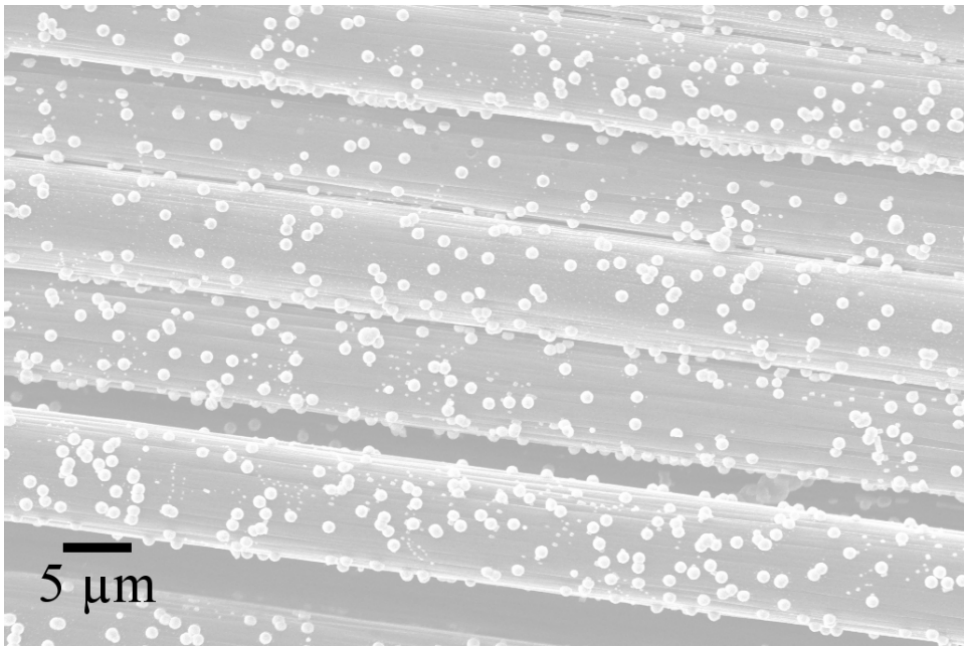


Fig. S3. EDS spectra of oxidized, nickel-coated UCFs.

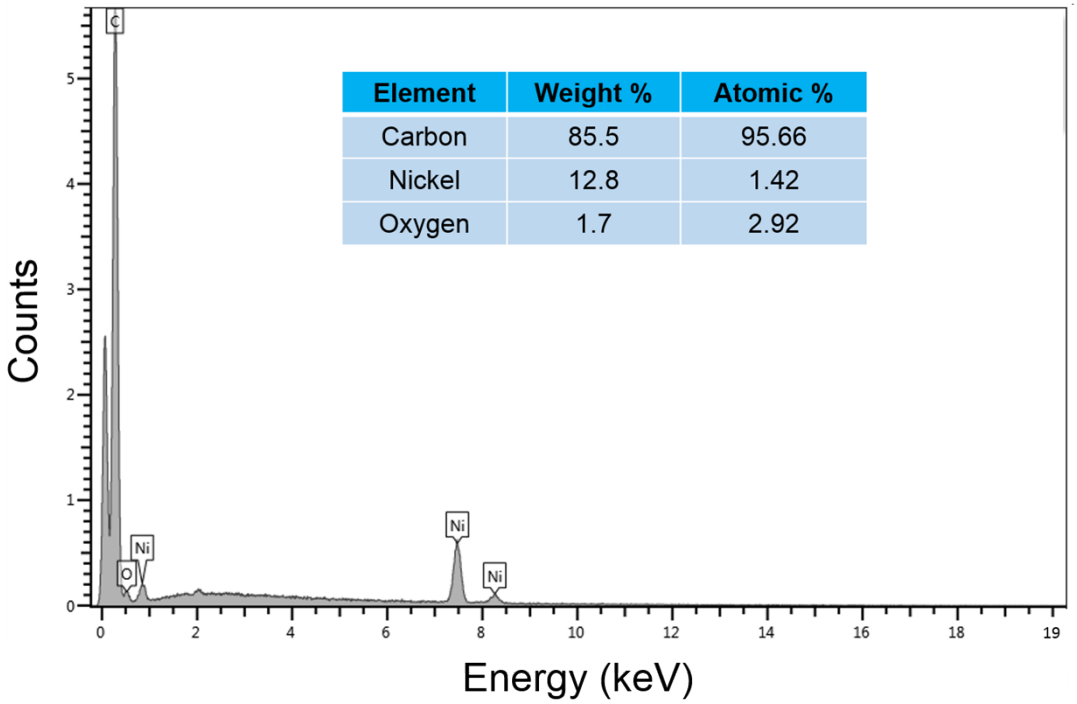


Fig. S4. Plot of variations in the volumetric capacitance of CNPs/UCF supercapacitor cell at different current densities.

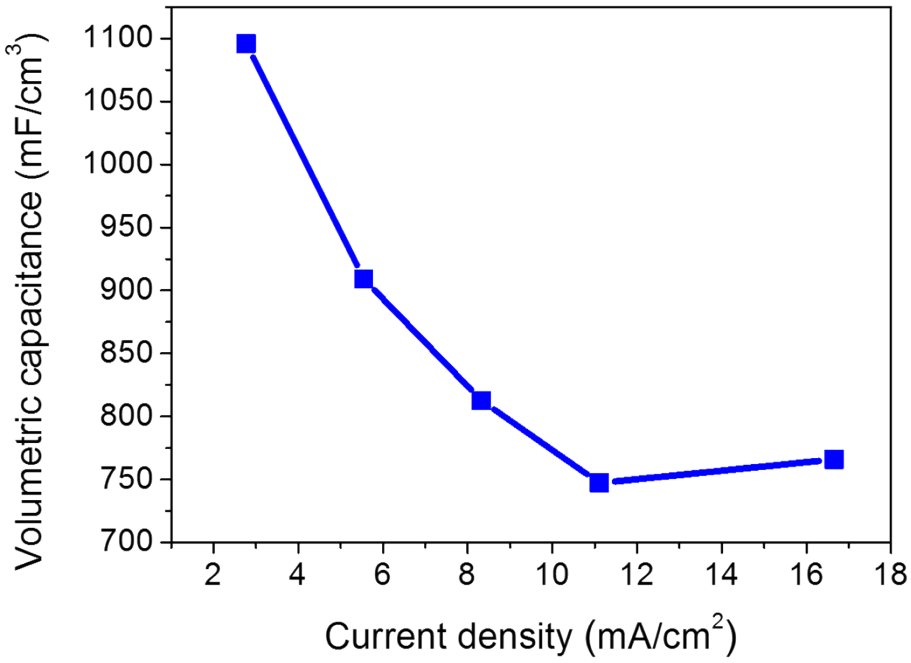


Fig. S5. Digital image of the two electrode cell set-up used for the testing of CNPs/UCF supercapacitor at various bending angles.

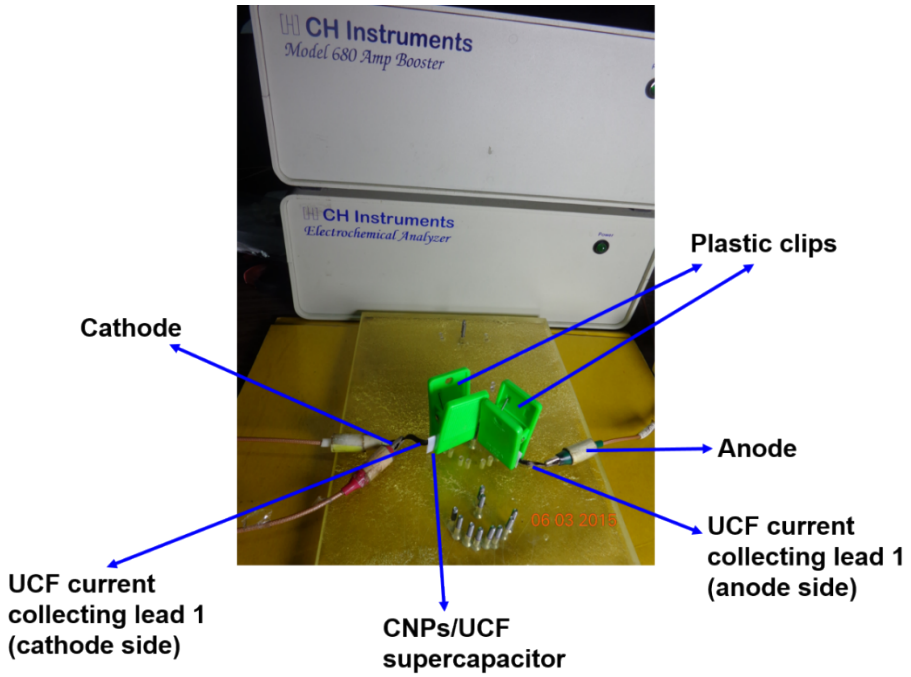


Fig. S6. Plot of percentage retention in the areal capacitance of CNPs/UCF supercapacitor cell at different bending angles.

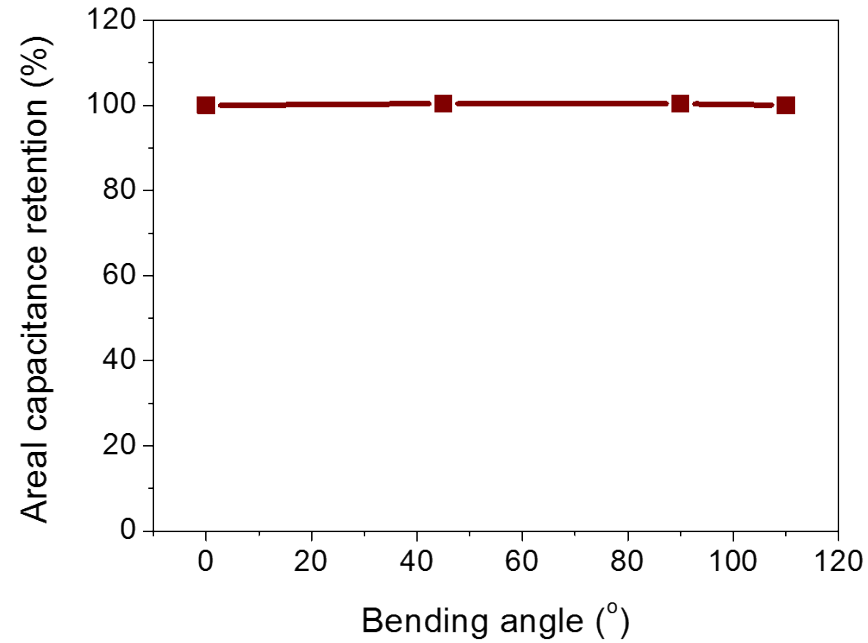


Fig. S7. Plot of percentage retention in the gravimetric capacitance of CNPs/UCF supercapacitor cell at different bending angles.

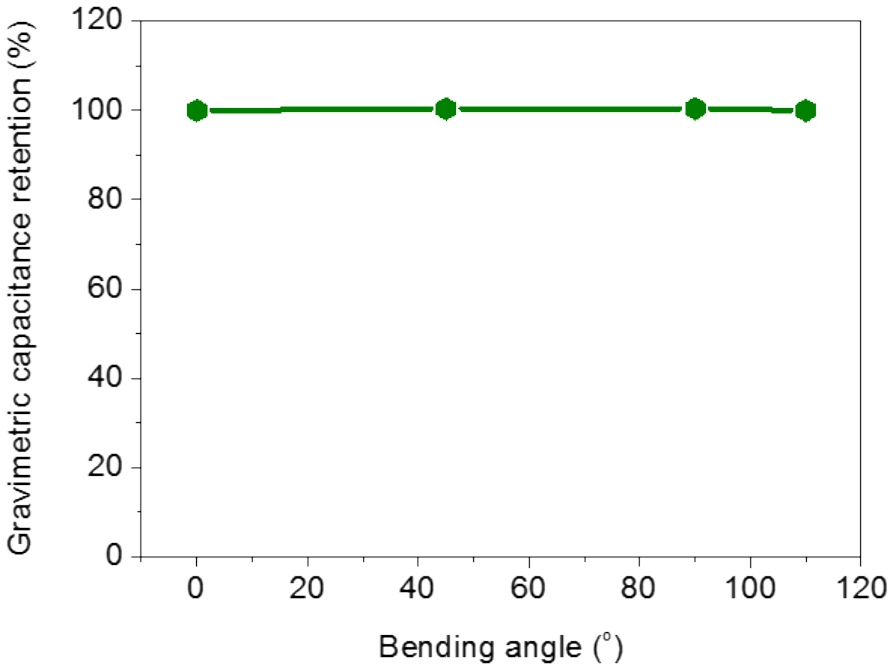


Fig. S8. Plot of variation in the volumetric capacitance of CNPs/UCF supercapacitor cell at different bending angles.

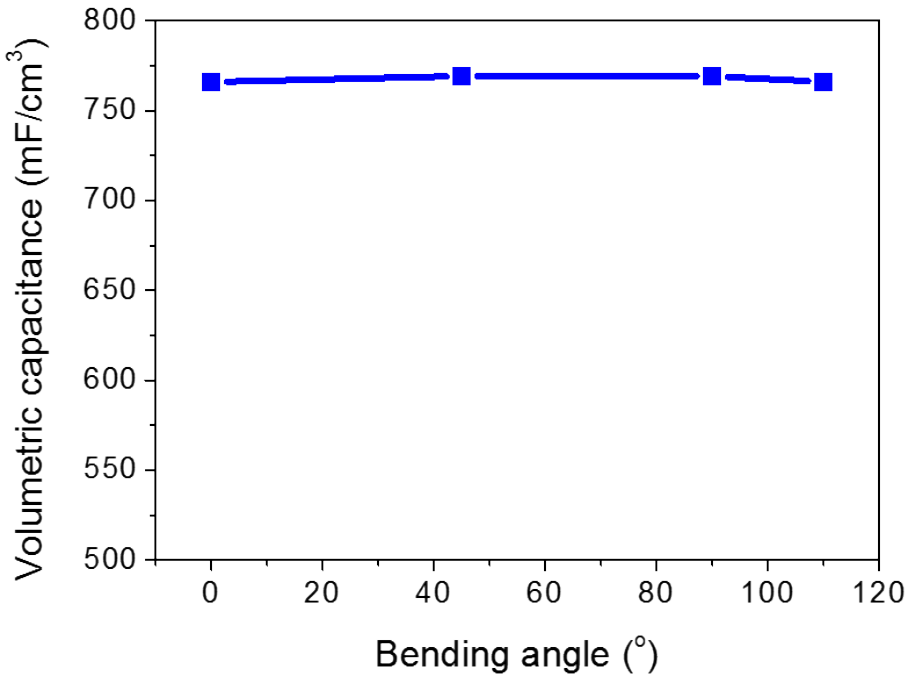


Fig. S9. Plots of percentage retentions in the volumetric and volume specific capacitances of CNPs/UCF supercapacitor cell at different bending angles.

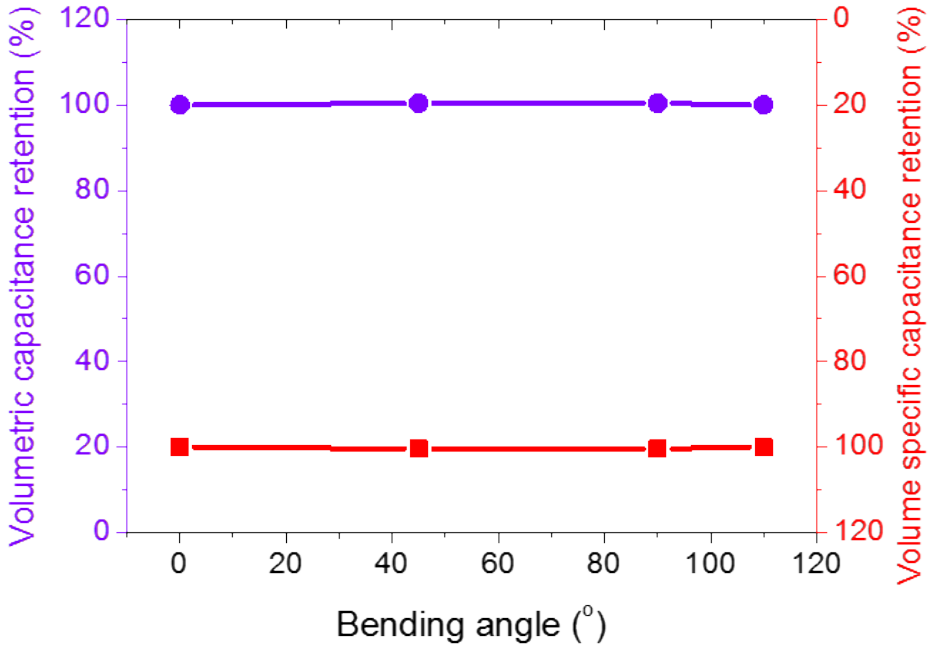


Fig. S10. Plot of variation in the gravimetric energy density of CNPs/UCF supercapacitor cell at different bending angles.

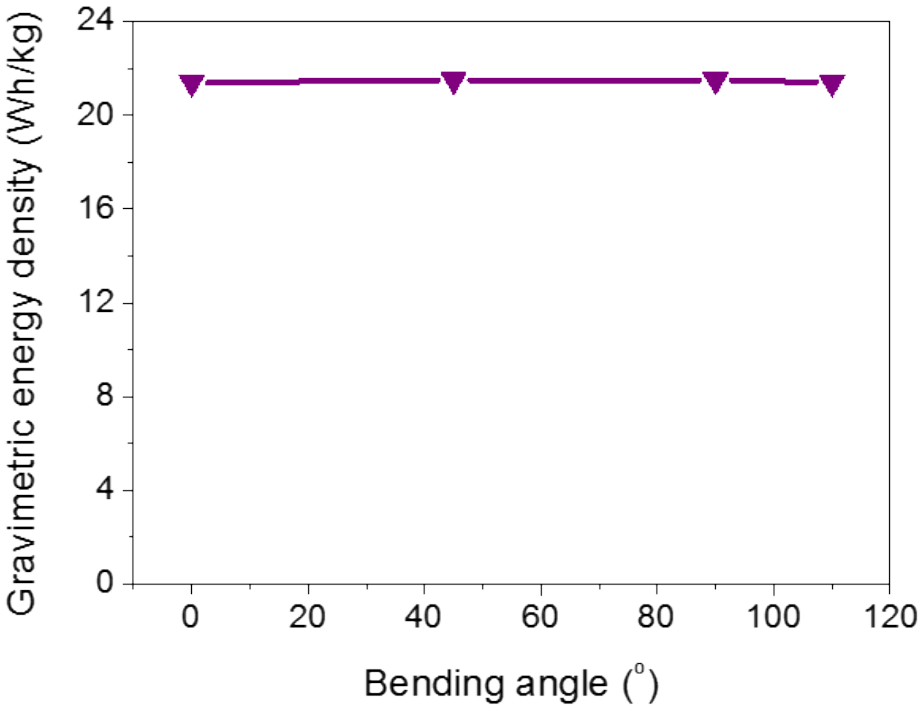


Fig. S11. Plots of percentage retentions in the volume specific and gravimetric energy densities of CNPs/UCF supercapacitor cell at different bending angles.

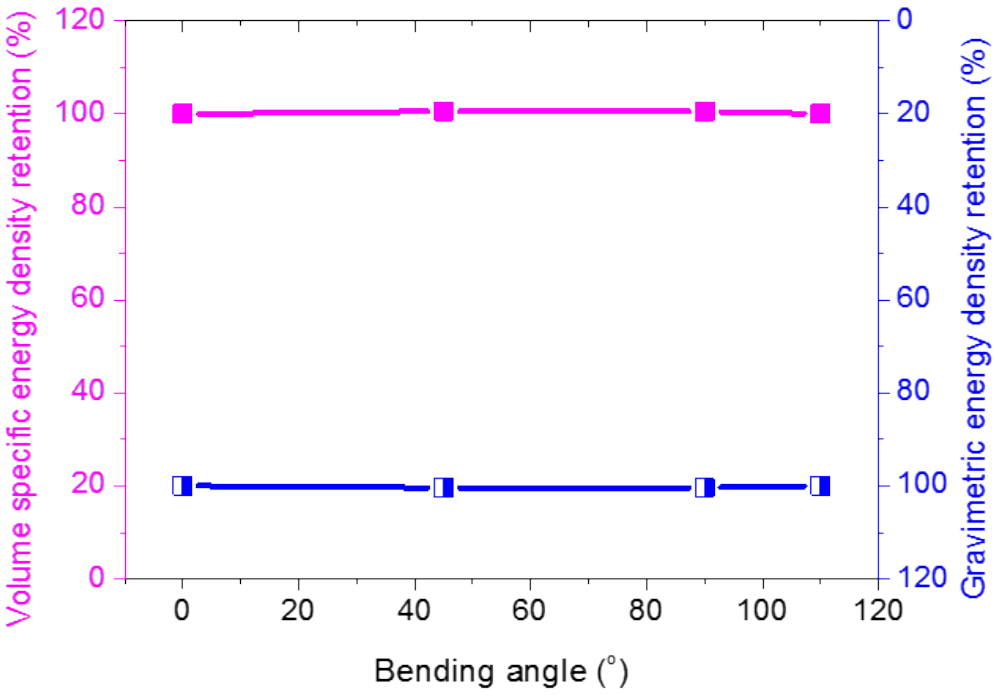
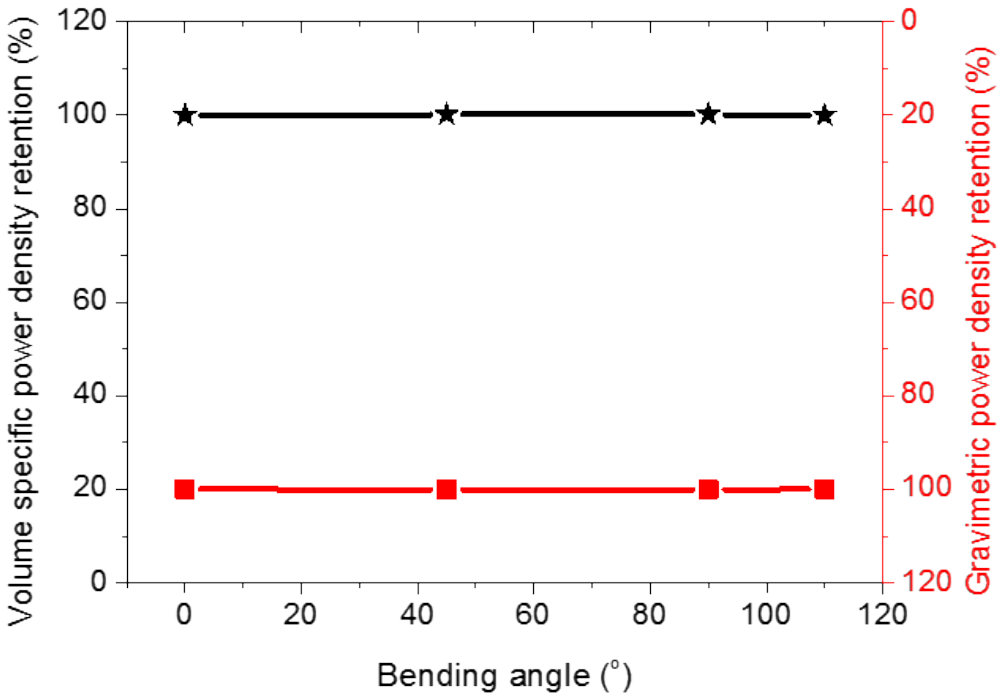


Fig. S12. Plots of percentage retentions in the volume specific and gravimetric power densities of CNPs/UCF supercapacitor cell at different bending angles.



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